it clear what action should be taken by the secondary system in the event that interference occurs." See TRW Comments at 136. It is not clear what TRW would like such a new rule to provide and what value TRW sees in an acknowledgment of potential interference. In any case, such a rule would be pointless. The existing Commission rules and international Radio Regulations clearly prescribe the status of a secondary service and the obligation of no harmful interference associated with that status. Any attempted elaboration of that obligation would needlessly constrain the flexibility of ad hoc coordination between the affected parties, especially where accurate methods for analyzing interference have not yet been developed.

The Report of Motorola on Band Segmentation Sharing presented to the Negotiated Rulemaking Committee recognizes that the potential exists for coupling secondary downlink energy from an Iridium spacecraft operating in the 1616-1626.5 MHz band into another spacecraft operating a primary uplink co-frequency in the 1613.8-1626.5 MHz band.[23/] This Report, however, went on to note that the potential for harmful interference is remote, at best, because:

- Band segmentation on a regional basis would be required to avoid interference to the primary uplinks of both systems. This would restrict each system to co-frequency uplink operations in regions with wide

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[23/] See Report of Motorola on Band Segmentation Sharing To Working Group 1 of the Above 1 GHz Negotiated Rulemaking Committee (Apr. 6, 1993) ("Report on Band Segmentation Sharing"), ¶ 4.0 et seq.

geographic separation. The actual separation of these systems would be developed during the Resolution 46 coordination process.

- The analysis of interference coupling between spacecraft constellations in different geographic regions where co-frequency, co-primary uplink operations could occur has not reached a sufficient level of accuracy.
- Permissible interference criteria between CDMA and TDMA/FDMA operators of MSS have yet to be developed.

Motorola's Report on Band Segmentation Sharing also identified a number of mitigation techniques which could be employed during the coordination process, including beam management, frequency management and selection of antenna polarization characteristics. See Report on Band Segmentation Sharing, ¶ 4.5. Either individually or in combination, these techniques would eliminate even the possibility of harmful interference to other MSS systems.[24/]

[24/] TRW's discussion of ITU-R work on this subject both within international and U.S. meetings of Working Party 8D misrepresents the technical issues. The input contribution in USWP-8D on this topic was made by TRW's own representative. The proposed interference model was an over-simplification of the complex statistical coupling problem. Its accuracy and limitations were not adequately explained to a majority of the delegation. In addition, the paper proposed reduction in user capacity as a criterion of "harmful interference" to a CDMA system. This criterion, however, is not generally accepted by the U.S. or world technical community. The one input on this topic at the international meeting of WP-8D was by the French Administration. The French delegation, however, refused to reveal the algorithms used to develop its computer model, making impossible an independent check of the accuracy of its calculations. Like TRW, the French also inappropriately used reduction in peak capacity to a (continued...)

G. A New Out-of-Band Emission Mask Is Necessary to Protect Both CDMA and TDMA/FDMA Systems

Motorola reemphasizes that the Commission must promulgate an out-of-band emission mask between the two band segments in lieu of the limits currently provided in § 25.202(f). The mask proposed by Motorola in its initial comments is structured so as not to be skewed in favor of either the CDMA or the FDMA/TDMA modulation, and is necessary to prevent harmful interference across the CDMA-FDMA/TDMA boundary, as well as among CDMA systems. The mask is also necessary to permit CDMA systems to operate down to 1610 MHz without causing harmful interference to GLONASS when GLONASS begins antipodal operations. The rationale for the recommended mask is fully set forth in the Technical Appendix to Motorola's Comments (Appendix 1 hereto).

III. THE RULES ON INTER-SERVICE SHARING MUST GIVE MSS LICENSEES SUFFICIENT FLEXIBILITY IN PROTECTING OTHER SERVICES

In their comments, many other MSS applicants have joined Motorola in requesting rules that enunciate a general obligation to avoid harmful interference where there is a need for protection of other primary services, but that also afford sufficient flexibility in choosing how to comply with this

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24/ (...continued)
CDMA system as equivalent to "harmful interference." The paper also was predicated on many other unwarranted and unstated assumptions. This paper was not approved at the meetings but simply kept as a working document until the French could provide significant improvements. Motorola has introduced a paper in the current US TG8/3 activities describing the errors in the French analysis.

obligation. Many MSS applicants also persuasively argue that the Commission should refrain from creating a second regulatory layer for inter-service sharing where the rules set forth in the international Radio Regulations are perfectly adequate for ensuring coordination and protection of other services. See, e.g., Constellation Comments at 51; LQP Comments at 66-67; TRW Comments at 125.

A. Radio Astronomy Service

In its Comments, Motorola pointed out that the Commission should refrain from codifying the numerical limits on out-of-band downlink emissions advocated by the radio astronomy interests. These limits were calculated on the basis of assumptions that are inapplicable to coordination between RAS and LEO MSS operations, including the use of an immobile interfering source providing a continuous output in the presence of continuum RAS observations. For this reason, Motorola recommended amending § 25.213(a) to substitute a general requirement of no harmful interference in place of any numerical limits.

Motorola can also endorse Constellation's recommendation that proposed § 25.213(a)(2) and (3) of the rules be deleted. Constellation correctly points out that the international Radio Regulations do not require protection of RAS from services in other bands except "to the extent that such services are afforded protection from each other." RR 344. The Commission should refrain from imposing on MSS systems any more

cumbersome obligations than those set forth in the international Radio Regulations.

The Committee on Radio Frequencies of the National Academy of Sciences ("CORF") itself acknowledges that the interference potential of MSS terminals is not well known at this time. See CORF Comments at 3. The Commission should refuse to follow the path of temporarily imposing overly-restrictive out-of-band limits without adequate knowledge of the MSS-RAS interference scenario, especially since those limits were derived on the basis of inapplicable assumptions. Rather, the lack of knowledge correctly identified by CORF militates in favor of imposing only a general obligation of no harmful interference instead of any temporary limits that would be subject to revision even under CORF's recommendations.

CORF also requests protection at all times when radio-astronomy observations have been scheduled, as opposed to protection during periods of actual observations, and asks for a relaxation of the notification requirements of § 25.213(a)(1)(v). Motorola cannot agree with that change. The minimum required of the radio astronomy interests in exchange for any obligations imposed on MSS system operators should be some scheduling discipline and a firm obligation to notify MSS licensees of scheduled observations. Adoption of CORF's recommendations would only encourage radio astronomers to be liberal in their scheduling of potential observations, thus imposing overly burdensome obligations on MSS systems by a stroke of CORF's scheduling pen. CORF should not be entitled to claim protection

for periods when a scheduled observation does not actually take place. Moreover, as agreed by CORF in the negotiated rulemaking, ESMU must, "to the greatest extent practicable," avoid scheduling observations during peak MSS traffic periods. See also Motorola Comments at 55 n.41.

Lastly, the Commission should decline to provide any protection or to make any provision for preserving access for radio astronomy observations above 1613.8 MHz. The request of Cornell University, the operator of the Arecibo Observatory, for preserving access to this spectrum to accommodate research of one of the states of Hydroxyl is unfounded. This spectrum is not allocated to RAS on a primary or secondary basis either domestically or internationally. Cornell tries to draw an analogy from "the 1330-1400 MHz band, where footnote US311 protection reminds other operators and administrations 'to take all practicable steps to protect spectral line observations of the radio astronomy service.'" Cornell Comments at 4. Of course, there is no such footnote applicable to the 1613.8-1660 MHz bands, and Cornell may not transplant protection from another portion of the spectrum to these bands.

B. Aeronautical Radionavigation Service and Radionavigation-Satellite Service

Motorola agrees with Constellation that the E.I.R.P. density limit of -15 dB(W/4kHz) "is the only enforceable sharing criterion that can be incorporated into the Commission's rules at this time, and that it is sufficient to recognize the status of GLONASS under RR 732 in the Commission's service rules for the

1.6/2.4 GHz MSS." Constellation Comments at 50; see also LQP Comments at 69. Accordingly, only the first sentence of § 29.213(c)(1) is truly necessary, and the remainder of this proposed rule can be deleted, as it merely reiterates obligations already enunciated by RR 731E and 731F. Motorola repeats, however, that the Commission should time average the E.I.R.P. values contained in § 25.213(c)(1) and treat them as triggers for coordination rather than absolute limits.

Not surprisingly, certain aeronautical interests have voiced again the same unpersuasive arguments that they made during the negotiated rulemaking. The Commission must not accept the contention of the FAA and Aeronautical Radio, Inc. ("ARINC") that the -15 dB(W/4kHz) criterion set forth in the international Radio Regulations is not sufficient to protect GLONASS receivers from harmful interference. In this regard, Motorola endorses the extensive analysis of LQP as to the levels required to protect GLONASS from harmful interference.

The international Radio Regulations provide ample protection for GLONASS high-altitude operations and the Commission should refuse to endorse any arbitrary restrictions on MSS operation that go beyond such protection, especially since the U.S. interest in using GLONASS for approach communications is lukewarm at best. Moreover, upon the near-certain relocation of GLONASS frequencies below 1610 MHz, the -15 dB(W/4kHz) level contained in RR 732 will no longer apply and the claim of GLONASS protection formerly arising thereunder will lack any basis.

Even if the Commission were to protect GLONASS receivers for approach communications, there would be no need whatsoever for adopting the overly restrictive values that are advocated by ARINC and FAA as out-of-band limits for MSS uplinks. These proposed limits are based on numerous flawed and unproven assumptions and are derived by an unsound analysis. As explained in detail in the Technical Appendix attached hereto as Appendix 1, ARINC's analysis assumes the geometric positions of an MSS transmitter and victim aircraft receivers to be static.[25/] Given the inherently mobile nature of both devices, this assumption alone totally skews the analysis. Further, no provisions are incorporated in the analyses of either ARINC or the FAA for the effects of duty cycle, modulation, technique, spectral overlap, channel assignment, airframe shielding, time duration of the event, and signal processing. No test data are provided by these commenters to support the derivation of an MSS power limit of -78 dB(W/MHz). See ARINC Comments at 4. The protection claimed as necessary by FAA and ARINC also rests on the erroneous assumption that corruption of a single measurement from a GLONASS satellite will cause unacceptable degradation in the ability to navigate. The study conducted for LQP by Sat-Tech Systems points out that the loss of a single satellite would never cause a loss of GNSS, since multiple measurements from a

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[25/] It should be noted that the analysis submitted by ARINC in the negotiated rulemaking assumed an MSS-aircraft separation distance of 100 meters, not 100 feet as reflected in the FAA's initial comments. See NRC Report 3.3.4.2; FAA Comments at 4.

number of GPS and GLONASS satellites would be available. See Technical Appendix to LQP Comments, ¶ 2.2.1., at 12.

As shown in the Technical Appendix, no harmful interference is expected to result to GLONASS from MSS transmitters if GLONASS relocates below 1610 MHz and MSS transmitters comply with the out-of-band emission mask recommended by Motorola. Motorola's analysis takes into account, among other things, aircraft system considerations, propagation path considerations, GLONASS channel availability, and the frequency and duration of interference events. Motorola's conclusions also rest on the improvement of the design of GLONASS receivers by incorporating a bandpass front end filter and a narrowband IF filter. Such filters are commonly employed by military and aviation receiver systems to prevent extraneous radiation from degrading receiver performance. Accordingly, the Commission should expressly condition any protection for GLONASS receivers on use of these filters.

IV. MSS LICENSING SHOULD NOT AWAIT THE RESOLUTION OF FEEDER LINK QUESTIONS IN ANOTHER PROCEEDING

As Motorola acknowledged in its initial Comments, the definitive resolution of all feeder link issues, including sharing with other services in the 27.5-29.5 GHz band, must await conclusion of the LMDS negotiated rulemaking proceeding. Motorola again urges the Commission expeditiously to pursue conclusion of that proceeding through the proposed regulatory negotiation. However, MSS licensing need not and should not await conclusion of the LMDS proceeding. The MSS applicants have

waited long enough to receive construction permits, and substantial portions of the MSS systems can be built before the definitive resolution of all issues relating to MSS feeder links.

Motorola agrees with the essence of TRW's observations regarding sharing between geostationary and LEO MSS systems in the Ka FSS bands. See TRW Comments at 138-147. Motorola interprets the Commission's proposed rules as endorsing the NRC's conclusion that geostationary and LEO operations in FSS bands should be equivalent. This equivalence is confirmed by proposed rule § 25.278, which imposes reciprocal coordination obligations on both geostationary and LEO licensees. Motorola also shares TRW's concerns regarding proposed § 25.203(k). Motorola does not believe that it was the Commission's intent to depart from equivalence and to impose an asymmetric obligation to applicants for LEO space stations. The rule was intended to apply to applicants for earth stations operating with both LEO and geostationary systems. Accordingly, as pointed out in Motorola's initial comments, the Commission should conform this proposed rule to the recommended NRC test by deleting the references to non-geostationary space stations.

V. THE COMMISSION SHOULD NOT SADDLE MSS SYSTEMS WITH CUMBERSOME EMERGENCY SERVICES OBLIGATIONS OR PUBLIC SERVICES SUBSIDIES

A. Emergency, Safety and Distress Services

As discussed in Motorola's initial comments, MSS systems can be expected to provide valuable emergency, safety and distress communications services. Motorola's IRIDIUM® system

will provide a variety of such services and capabilities, including: routing of distress messages to the appropriate responding parties or authorities; the ability to return calls to the distressed party; priority communications for Search and Rescue and Emergency Services; and a capability for location of the calling party in remote locations. To the extent that the IRIDIUM® system and other MSS systems will be able to network through the public switched network, the IRIDIUM® system will also provide seamless communications between users of different MSS systems and standardized protocols for routing of data messages, which will in turn make possible interoperable communications between fire, police and other government agencies using MSS systems.

In the first round of comments, however, some parties (Bernard J. Trudell, the Texas Advisory Commission on State Emergency Communications ("TX-ACSEC"), the U.S. Coast Guard, the National Association of EMS Physicians and the Interagency Committee on Search and Rescue) have urged the Commission to impose on MSS systems inflexible and expensive requirements pertaining to 911 interconnection and location information delivery, including the obligations enunciated by the Commission in its Report and Order in In re Rules and Policies Regarding Calling Number Identification Service -- Caller ID, 9 FCC Rcd. 1764 (1994) ("Caller ID Report and Order").[26/]

[26/] The Manager of the National Communications System also asks the Commission to "confirm that all of the new licenses should give consideration to NS/EP [National Security/Emergency Preparedness] requirements and cooperate in meeting them." See (continued...)

Transplanting these requirements from local exchange and long-distance common carriers to MSS systems would obligate MSS systems to adhere to a specific technical model. See Caller ID Report and Order, 9 FCC Rcd. at 1764-65. Among other things, this model assumes use of a specific type of network (Signalling System 7, or "SS7," networks). Investment in SS7 technology is so expensive that the Commission has declined to require even existing common carriers and long distance providers to use it. The new rules merely impose certain obligations if SS7 technology is employed. See id.

Imposition of such obligations would carry with it a whole range of cumbersome requirements, including the obligation to implement automatic per call blocking mechanisms and disclosure requirements. Caller ID Report and Order, 9 FCC Rcd. at 1765. Some of these requirements cannot readily be complied with by MSS systems. The Commission has so far refrained from imposing such obligations on cellular and personal communications services, Second Report and Order, Amendment of Rules to Establish New PCS, 8 FCC Rcd. 7700, 7756 (1993), and should not do so in this proceeding with respect to MSS systems.

There are additional reasons for not imposing such requirements on MSS systems. By substantially adding to the cost of implementing U.S. MSS systems, these obligations would place

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26/ (...continued)
National Communications System Comments at 3. Motorola does not interpret this invitation as requesting the imposition of an obligation to participate in the NS/EP program and believes that any requirements relating to NS/EP services can only apply if an MSS provider chooses to participate in the provision of such services.

them at a competitive disadvantage vis-à-vis providers that might not be so burdened. In addition, compliance with these requirements might run afoul of the applicable laws and regulations in other countries where MSS systems will seek to provide service. Caller identification, for example, is prohibited in many countries, and such a capability might create licensing and compliance difficulties for MSS systems in those countries.

Finally, the creation of obligations in the area of distress communications could raise questions of privacy, state law violation and the need of express preemption thereof, or even of potential liability of MSS licensees with respect to injury or damage caused in the proximity of an MSS terminal. While Motorola supports Trudell's request for Congressional action to immunize MSS licensees from such liability, see Trudell Comments at 4, the fact is that such action has not yet been taken and cannot be forced upon Congress by the Commission. As the Commission recently determined in response to the Petition for Reconsideration filed by TX-ACSEC in the PCS proceeding, the issues relating to Enhanced-911 capability and raised by TX-ACSEC can only be addressed in a separate future rulemaking proceeding. See Amendment of the Commission's Rules to Establish New Personal Communications Services, GEN Docket No. 90-314, RM-7140, RM-7175, RM-7618 (rel. June 13, 1994), at ¶ 202.

In the Little LEO Order,[27/] the Commission rejected arguments very similar to those made here by the safety and emergency services interests. The Commission agreed with one of the commenters that the NVNG MSS is not a designated safety service and that the costly service options whose imposition had been requested "should be undertaken voluntarily by the licensees only if a market for these services appears to exist." Little LEO Order, 8 FCC Rcd. at 8458. Accordingly, the Commission held that "the NVNG services are not intended to replace existing international safety services and cannot be used in lieu of distress beacons that are required to be carried by international agreement or statute." Id. (footnote omitted). Likewise, in the case of Big LEO MSS, the marketplace should ultimately determine whether these new services can complement designated safety services. There is no need to constrain MSS systems by cumbersome requirements that may raise thorny legal problems and may inhibit international MSS operations and competition.

In this respect, the comments filed by MDC and COMSAT reflect a fundamental misconception of the NPRM's discussion with respect to maritime safety and distress services. See MDC Comments at 14; COMSAT Comments at 13-14. Proposed rule § 25.143(f) makes clear that the Commission does not propose to impose the obligation to provide such services, consistent with the Commission's decision in the Little LEO Order. Rather, the proposed rule merely points out that MSS systems may become

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[27/] Amendment of the Commission's Rule to Establish Rules and Policies Pertaining to a Non-Voice, Non-Geostationary Mobile Satellite Service, 8 FCC Rcd. 8450 (1993) ("Little LEO Order").

subject to 47 U.S.C. §§ 321(b) and 359 if they are used to comply with any of the relevant requirements enunciated by statute or international agreement, such as the International Convention on the Safety of Life at Sea, 32 U.S.T. 47, T.I.A.S. 9700 (1974).

B. Public Service Users

Several commenters recognize the important potential of MSS for educational and public service uses. See Joint Comments of the Association of America's Public Television Stations and Public Broadcasting Service at 2 ("APTS-PBS"); Comments of National Public Radio at 2; Comments of Corporation for Public Broadcasting ("CPB") at 2-3. Motorola recognizes the importance of MSS for educational and public service; however, Motorola does not support mandatory requirements that private MSS operators subsidize educational and public services as requested by these parties. MSS systems are new and have only a limited capacity. These fledgling businesses should not be burdened with the requirement that they dedicate a portion of their capacity to non-revenue generating activities. An obligation to dedicate a percentage of each system's capacity to educational purposes would unduly constrain MSS systems, not least because the capacity needs of educational and environmental services cannot be foreseen at this time. Nor should the Commission impose such requirements only on MSS licensees, handicapping them in their ability to compete with other wireless services and with foreign MSS providers.

There is no record in this rulemaking proceeding on which to base the imposition of capacity set-asides or subsidies for MSS licensees. As CPB acknowledges, it "is not yet able to offer the Commission information about the comparable costs of the means through which these educational services are provided today. CPB is even less able to anticipate the costs of other means of distributing such services." CPB Comments at 4. Other mechanisms -- such as the use of proceeds from the Universal Service Fund -- should be considered as potential alternatives to the proposals made by these commenters. For all these reasons, set-asides for educational and public service uses should be voluntary for MSS operators, not mandatory.

VI. THE PROVISION OF BULK SPACE CAPACITY BY MSS SYSTEMS TO PROVIDERS OF COMMERCIAL MOBILE RADIO SERVICES IS NOT COMMON CARRIAGE

Several parties have joined Motorola in pointing out that the provision of wholesale space capacity on MSS systems is not common carriage as a matter of law and policy. See TRW Comments at 152-68; LQP Comments at 96-101; Constellation Comments at 60-61; Ellipsat Comments at 45-46. The Commission has express statutory discretion to determine whether the provision of space segment capacity qualifies as common carriage, guided by the standard of NARUC I, see 47 U.S.C. § 332(c)(5), and has decided to exercise its discretion in this proceeding. Implementation of Sections 3(n) and 332 of the Communications Act, Second Report and Order, GN Docket No. 93-252 ¶ 108 (released Mar. 7, 1994). Application of NARUC I mandates a

finding that the provision of bulk space capacity does not constitute common carriage. This conclusion is buttressed by strong policy considerations (also reflected in the Note Verbale of the European Delegation). The need to secure worldwide financing and the provision of global service are not compatible with, and would be compromised by, a legally unsustainable finding of common carriage.

VII. MOTOROLA'S FINANCING EFFORTS FOR THE IRIDIUM® SYSTEM HAVE NOT VIOLATED ANY OF THE COMMISSION'S RULES

TRW does not advance the debate on the licensing and service rules proposed by the Commission by interjecting an attack on Motorola's successful first round financing for the IRIDIUM® system. TRW's attack is completely unfounded.

Motorola's efforts to secure equity financing and strategic partners for the IRIDIUM® system has not violated any Commission rule or policy. The application for the IRIDIUM® system was filed by Motorola. Motorola has always been the applicant for the IRIDIUM® system and the real party in interest in this proceeding. It will operate and maintain the satellite constellation as well as the network control facilities for the IRIDIUM® system. Motorola has never changed its corporate structure and remains a wholly-owned subsidiary of its parent corporation. There has never been any "substantial change in beneficial ownership or control" of the applicant, either de jure

or de facto, which would qualify as a "major amendment" falling within § 25.116(b)(3), and (c) (1993).

TRW can rest assured that if, subsequent to receiving a license for the IRIDIUM® system, Motorola desires to transfer its license to another entity or to effect a change in identity of the party controlling its affairs, it will take all steps necessary to comply with the requirements of the Communications Act, 47 U.S.C. § 310(d), and the Commission's rules, 47 C.F.R. § 25.118, as well as with the proposed anti-trafficking rule, § 25.143(g). As noted in Motorola's initial comments, it interprets the proposed anti-trafficking rule as allowing changes in the licensee's structure that could result from additional equity participation, subject to satisfaction of the requirements of § 25.118.[28/]

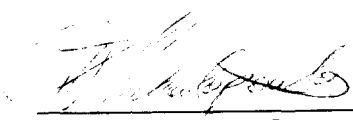
[28/] The language quoted by TRW from Motorola's contracts merely confirms that Motorola will maintain control over the operation of the satellite system.

VIII. CONCLUSION

For the reasons stated herein and in its initial Comments, Motorola urges the Commission to adopt its proposed licensing and service rules expeditiously.

Respectfully submitted,

MOTOROLA SATELLITE
COMMUNICATIONS, INC.



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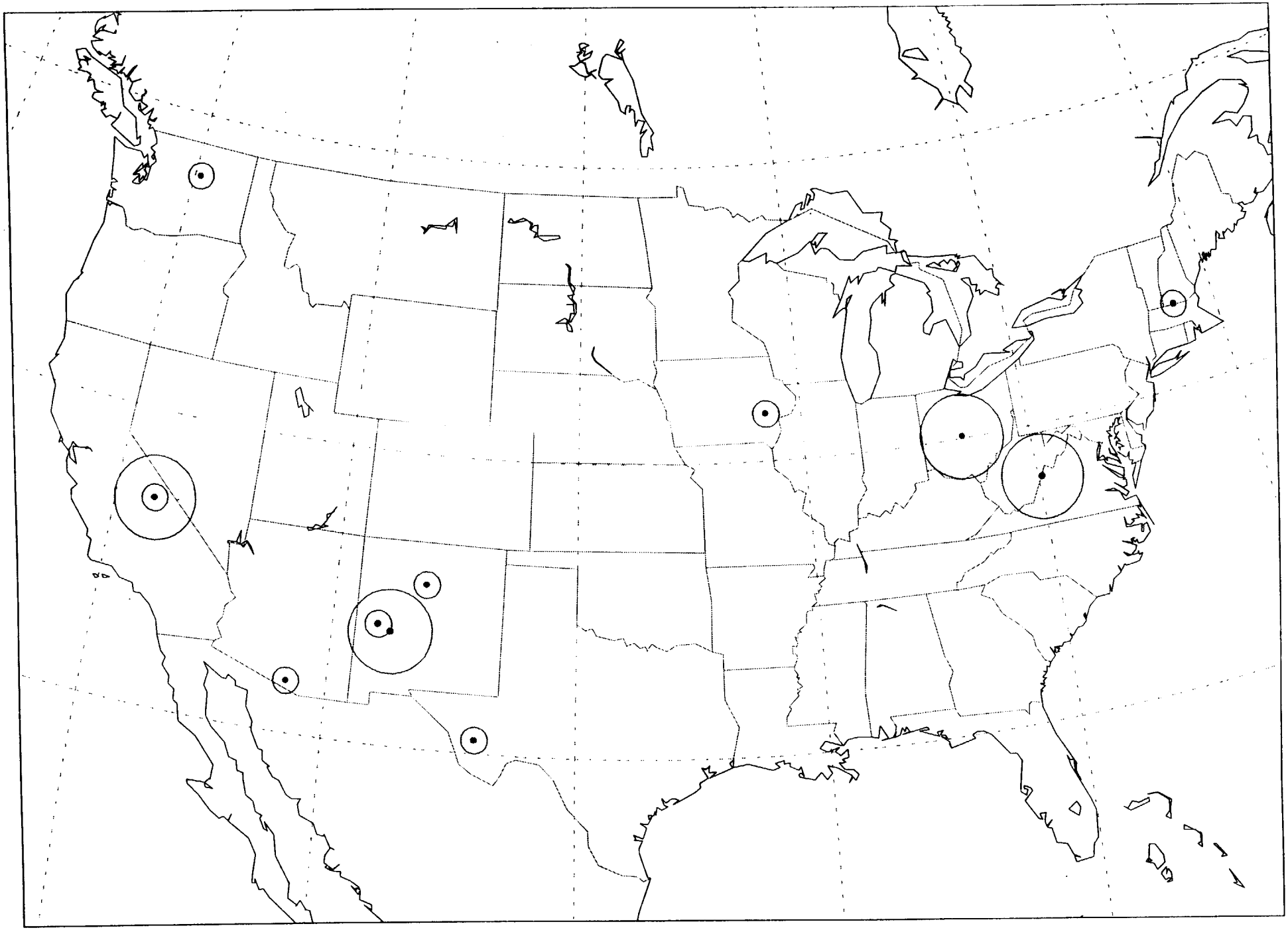

MSS-GLONASS, AVIATION COMPATIBILITY

June 17, 1994

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ABSTRACT

This paper shows that, using realistic out-of-band emission parameters, a well designed CDMA system can occupy the 1610.0 - 1618.25 MHz band without causing harmful interference to the GLONASS system operating antipodal in the adjacent band. The paper introduces a comprehensive method for determining harmful interference to an aviation GLONASS receiver resulting from the operation of Mobile Satellite System (MSS) subscriber units near an airport.

MSS-GLONASS, AVIATION COMPATIBILITY
June 17, 1994

1. INTRODUCTION

1.1 MSS L-Band Frequency Allocations

The World Administrative Radio Committee of 1992 (WARC-92) assigned Mobile Satellite Service (MSS) the band 1610.0 - 1626.5 MHz for purposes of satellite communications. This assignment provides primary status for uplink communications in the entire band and secondary status for downlink communications in the 1613.8 - 1626.5 MHz band. The band includes provisions for Aeronautical Radionavigation Service as primary in the space-to-earth direction. Also, the Radio Astronomy Service is designated primary in the 1610.6 - 1613.8 Mhz portion of the band.

The recently published "FCC Notice of Proposed Rule Making," Docket No. 9, suggests that the band be subdivided such that CDMA MSS systems initially operate in the 1610.0 - 1621.35 MHz region, and that TDMA MSS systems operate in the 1621.35 - 1626.5 MHz region. MHz region.

International Radio Regulations require that systems which share a common band not cause harmful interference with each other.

The matter of band sharing has been reviewed in depth by members of the MSS community, the Radio Astronomy Service, the Federal Aviation Agency, the Federal Communications Commission, the US State Department, MSS equipment manufacturers, and other communications network operators interested in the use of the band. It is the consensus of the MSS community that band utilization is best accomplished by relocating GLONASS to frequencies lower than 1610.0 MHz. The Russian Government has been formally requested to review the matter and has agreed in principal that relocation is possible by making use of similar frequencies in antipodal GLONASS satellites, and/or by reducing the guard band between GLONASS and the Global Positioning System (GPS). The net result could be a 12 channel GLONASS configuration (instead of the current 24 channel configuration) located in a region below 1610.0 MHz. This paper assumes that GLONASS will be eventially operate antipodal in the region 1602.15 - 1609.26 MHz. With this change in the GLONASS frequency plan, CDMA MSS systems should be able to operate in the entire CDMA band segment without any appreciable restrictions or service protection constraints

1.2 Example CDMA MSS System

An example of a CDMA MSS system is the Globalstar concept. This system employs a network of 48 "bent pipe" satellites operating with companion subscriber units on a Code Division Multiple Access modulation plan. Initial CDMA operations are planned for the frequency band 1610.0 - 1621.35 MHz. The assigned spectrum will be subdivided by Globalstar into a number of 1.25 MHz wideband CDMA channels. Other CDMA MSS systems that may share the band on an interference sharing basis are Odyssey, Constellation, and Ellipsat.

1.3 Generic MSS-Aviation Compatibility Analysis

The general GLONASS compatibility problem is that all of the MSS systems plan to transmit in the earth-to-space direction using L-band. If an MSS subscriber unit(s) were to be utilized in the near vicinity of an airport, there is the possibility of interference with GLONASS receivers. The problem is dynamic, however, since the MSS subscriber can be in motion and a GLONASS equipped aircraft may be in motion. For example, an active MSS subscriber could be located in a vehicle traversing a road located beneath the final approach path to an airport. Out-of-band emission from an MSS subscriber unit conceivably could be detrimental to aircraft equipped with a GLONASS receiver, if operated during times that GLONASS is being employed for radionavigation purposes.

The MSS-GLONASS aviation spectral compatibility problem has been examined by agencies associated directly with aviation as well as by members of the MSS community. Unfortunately many of the analyses have been simplified to the point where they become unrealistic in their conclusions. To be valid, both the general and the detailed aspects of the interference problem must be considered. Further, since both the subscriber and the aircraft are in motion, the problem must be examined statistically in order to obtain valid results.

2. Overview of Interference Analysis Method

To determine whether harmful interference exists between an MSS system and GLONASS, a number of factors must be carefully considered. It is necessary to develop an estimate of Effective Spectral Power Flux Density (ESPFD) incident upon the GLONASS receiver's antenna aperture. This requires knowledge of the geometry between the transmitter element and the receiver antenna, an estimate of Effective Isotropic Radiated Power (EIRP) and an estimate of receiver antenna gain. Receiver antenna gain is dependent upon the antenna pattern. The receiver antenna pattern is also subject to blockage from its parent airframe. Boeing Aircraft Co. estimates that airframe blockage can attenuate signals by 15 dB for sources abeam an aircraft to as much as 30 dB for a radiation source beneath the aircraft.

Since the GLONASS receiver is a CDMA device, interference power is "spread" over the bandwidth of each channel (1.125 Mhz). In addition, signal integration is provided to generate the final 50 bit/sec data rate. Consideration must also be given to MSS duty cycle effects as well as spectral overlap power in the determination of interference.

Harmful interference to a GLONASS receiver depends upon:

a. The susceptibility of the aviation system to interference.
b. The spectral power flux density present
c. The time duration of an interference event,
d. The frequency of an interference event